ANNUAL REPORT

OF THE **STATE GEOLOGIST** TO THE **GOVERNOR**

Volume 55
1985

State of Iowa
Iowa Geological Survey

123 North Capitol Street • Iowa City, Iowa 52242 • (319) 338-1173

Terry E. Branstad
Governor of Iowa

Donald L. Koch
State Geologist and Director

Bernard E. Hoyer
Associate State Geologist

May 12, 1986

Governor Terry E. Branstad
State Capitol Building
Des Moines, IA 50319

Dear Governor Branstad:

In accordance with the Code of Iowa, Section 305.7 and Section 17.4, I hereby transmit to you the *Annual Report of the State Geologist to the Governor*. It describes accomplishments and activities of the Iowa Geological Survey for the period January 1, 1985 to December 31, 1985 and includes a financial statement for FY 85. The legal responsibilities of the Survey are set forth in the Code of Iowa, Chapters 305 and 84. I believe an examination of this report will demonstrate that the Survey is providing information and services valuable to the proper protection, management, and development of our state's natural resources, as well as striving to improve the necessary information base to meet anticipated needs in the years ahead.

Respectfully submitted,

Donald L. Koch

Donald L. Koch
Director and State Geologist

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IOWA GEOLOGICAL SURVEY
123 North Capitol Street
Iowa City, Iowa 52242

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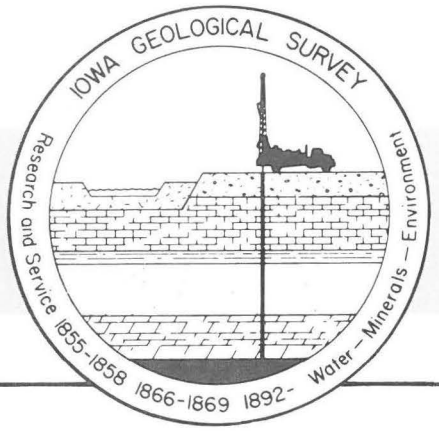
Iowa Geological Survey



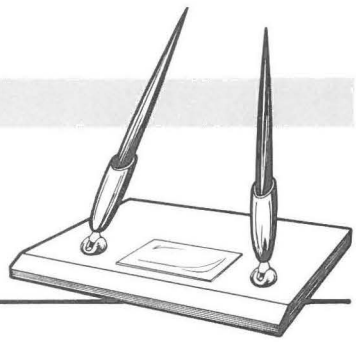
The Iowa Geological Survey was permanently established as a public service and research agency in 1892, following two earlier reconnaissance surveys of Iowa geology commissioned between 1855 and 1859, and again from 1866 to 1869. The Survey was charged with the responsibility "...to make a complete survey of the natural resources of the state in all their economic and scientific aspects..." Today, as then, IGS has the responsibility to collect, manage, interpret, and report geologic and hydrologic information that is relevant to Iowa's resource development and protection. In addition, IGS administers the rules for oil, gas, and metallic minerals exploration in conjunction with the Iowa Department of Soil Conservation.

Geological resources are vital elements in our state's future. Iowa has significant water, mineral, rock, soil, and energy resources, but they are finite; they are distributed unevenly in terms of quantity and quality; and often they are vulnerable to contamination and misuse. Further, there are competing interests for their development and utilization. The State needs impartial, independent, and technically qualified sources of information to provide balance and credibility in the resolution of natural resource issues.

It is the Survey's goal to assist Iowa's diverse public interests by providing reliable natural resources information. We acquire and maintain basic resource data directly through our own programs and cooperatively with other agencies. Our staff interprets geologic and hydrologic data in response to both immediate and long-range needs identified in the areas of water supply, environmental protection, and economic development. Considerable attention also is given to developing better analytical capabilities so that our information and services continue to improve. Assistance to the public is provided through the development of publications, public presentations, and most commonly, in personal response to specific questions raised by public officials, engineers, lawyers, and private citizens.

Through the years, the Iowa Geological Survey has developed valuable resource information in response to the state's needs. The data bases grow daily; tools for data management and analysis improve regularly; and the staff continues to provide unbiased, reliable information to all. This Annual Report provides a summary of Iowa Geological Survey activities during 1985.

Administration



Director and State Geologist

The Director and State Geologist is appointed by the Governor of the State of Iowa. It is the State Geologist's responsibility to plan and manage Iowa Geological Survey programs so that the agency's service and research objectives, as well as administrative responsibilities pertaining to the Oil, Gas and Metallic Minerals law, may be met. The State Geologist represents IGS on various boards and committees, and frequently represents the State at public meetings pertaining to natural resource issues.

Organization And Staff

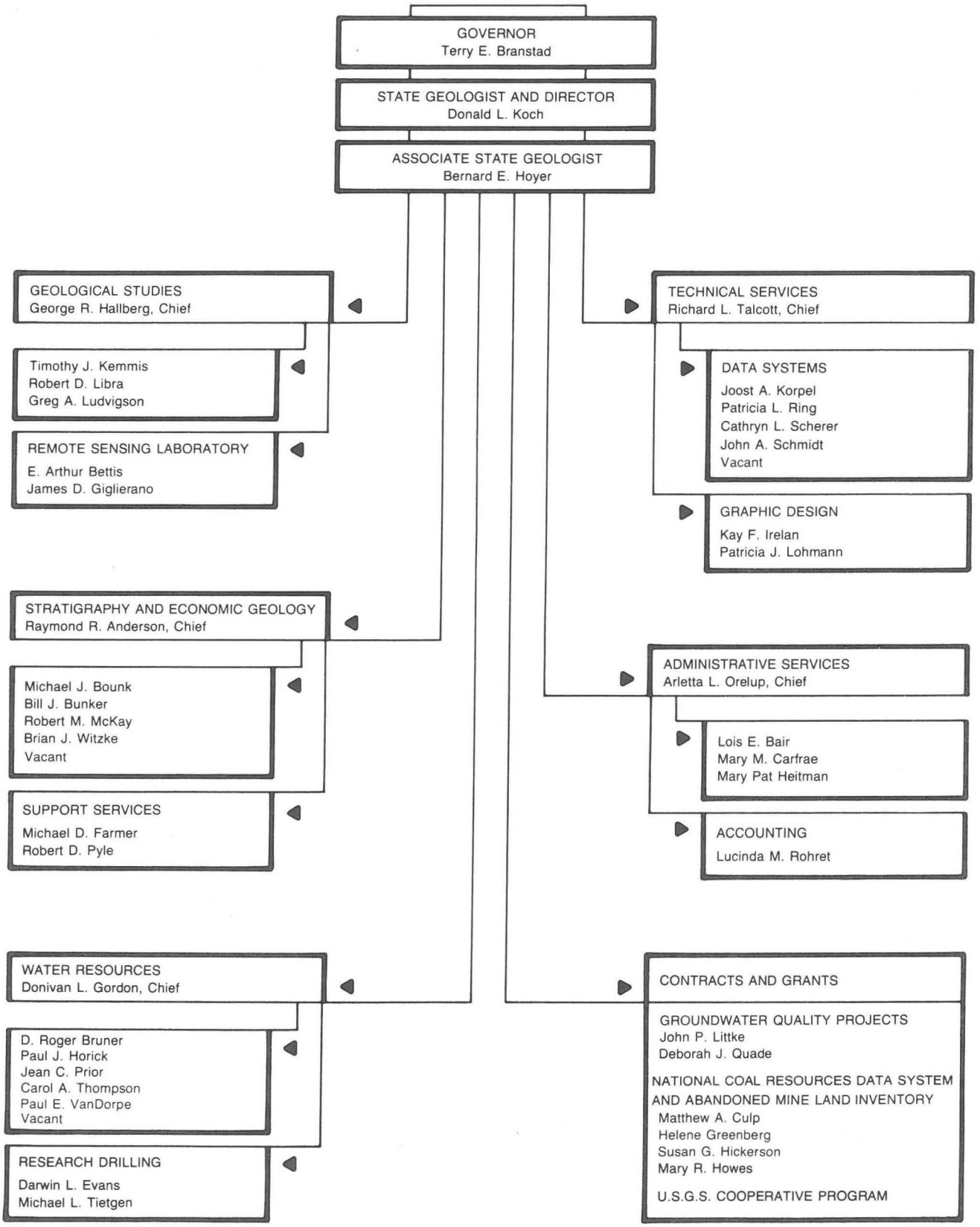
The Iowa Geological Survey consists of five operational divisions: Geological Studies, Stratigraphy and Economic Geology, Water Resources, Technical Services, and Administrative and Support Services. At the conclusion of 1985, IGS was staffed by 44.5 full-time equivalent positions, including 24 geologists and geohydrologists. A table of organization is provided on the following page.

Finances

The Iowa Geological Survey had available funds of $1.9 million during fiscal year 1985 including $1.6 million in the general account and 0.3 million in contracts and grants. During the year, revenues from state appropriations totaled $1.5 million, contracts and grants totaled $147,000, and map and publication sales totaled $29,000.

Total expenditures equaled $1.8 million for FY 86, including $1.6 million from the general account and 0.2 million through contracts and grants. Staff salaries are the largest single expenditure item, about $1.1 million, followed by services procured through cooperative agreements with the U. S. Geological Survey for stream gaging, water-quality analyses, water studies and topographic map production, about $247,000.

At the close of FY 85, about $22,000 reverted to the State Treasury and about $70,000 of contract and grant monies were carried over into FY 86. A financial statement for FY 85 is included on page 5.


GOVERNOR
Terry E. Branstad
STATE GEOLOGIST AND DIRECTOR
Donald L. Koch
ASSOCIATE STATE GEOLOGIST
Bernard E. Hoyer
GEOLOGICAL STUDIES
George R. Hallberg, Chief
Timothy J. Kemmis
Robert D. Libra
Greg A. Ludvigson
REMOTE SENSING LABORATORY
E. Arthur Bettis
James D. Giglierano
STRATIGRAPHY AND ECONOMIC GEOLOGY
Raymond R. Anderson, Chief
Michael J. Bounk
Bill J. Bunker
Robert M. McKay
Brian J. Witzke
Vacant
SUPPORT SERVICES
Michael D. Farmer
Robert D. Pyle
WATER RESOURCES
Donivan L. Gordon, Chief
D. Roger Bruner
Paul J. Horick
Jean C. Prior
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Paul E. VanDorpe
Vacant
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Darwin L. Evans
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Richard L. Talcott, Chief
DATA SYSTEMS
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Patricia L. Ring
Cathryn L. Scherer
John A. Schmidt
Vacant
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Kay F. Irelan
Patricia J. Lohmann
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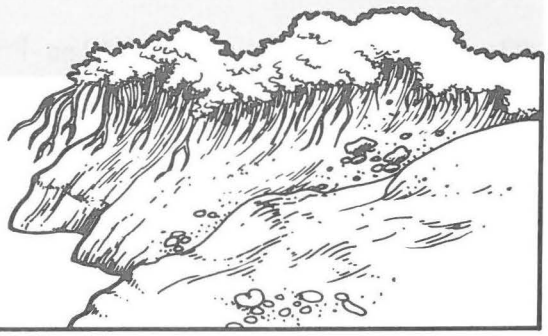
Arletta L. Orelup, Chief
Lois E. Bair
Mary M. Carfrae
Mary Pat Heitman
ACCOUNTING
Lucinda M. Rohret
CONTRACTS AND GRANTS
GROUNDWATER QUALITY PROJECTS
John P. Littke
Deborah J. Quade
NATIONAL COAL RESOURCES DATA SYSTEM
AND ABANDONED MINE LAND INVENTORY
Matthew A. Culp
Helene Greenberg
Susan G. Hickerson
Mary R. Howes
U.S.G.S. COOPERATIVE PROGRAM

IOWA GEOLOGICAL SURVEY
FINANCIAL STATEMENT
YEAR ENDING JUNE 30, 1985

	General Account	Contracts and Grants	Total
AVAILABLE FUNDS			
Contracts and Grants		77,617	
Flow Through Accounts		37,250	
Vehicle Depreciation	11,689		
Capital Improvements	1,526		
TOTAL BEGINNING BALANCE (7/1/84)	13,215	114,867	128,082
State Appropriations with Salary Adjustments	1,517,374		
Map and Publication Sales	28,943		
Reimbursements	6,199		
Vehicle Depreciation	15,451		
Indirect Costs	33,742		
Kansas Center for Research	4,436		
Contracts & Grants		147,447	
Flow Through Account		29,200	
REVENUES IN FY 85	1,606,145	176,647	1,782,792
TOTAL AVAILABLE FUNDS FOR FY 85	1,619,360	291,514	1,910,874
EXPENDITURES			
Salaries	1,004,324	72,987	
General Supplies	68,635	15,941	
Telephone, Rentals, Utilities	26,770		
Data Processing	27,190		
Printing	26,174	2,182	
Service Contracts	35,595		
Professional Services	34,525	12,933	
Travel	20,117	11,980	
Vehicle Dispatcher	32,651		
Equipment	45,402	8,177	
Vehicles	28,008		
Indirect Costs		33,742	
Flow Through Account		63,100	
Capital Improvements	1,487		
Cooperative Agreement Water Resources Division, USGS	169,202		
Cooperative Agreement, Topographic Division, USGS	78,000		
Year End Reversion to State Treasury	22,148		
TOTAL EXPENDITURES FOR FY 85	1,620,228	221,042	1,841,270
BALANCE			
Contracts and Grants		70,472	
Vehicle Depreciation	(868)		
TOTAL ENDING BALANCE FOR FY 85 (6/30/85)	(868)*	70,472	69,604

* Recovered in August after sales of replaced vehicles

Geological Studies



HYDROGEOLOGIC STUDIES

Agricultural Chemicals and Groundwater Quality

IGS studies of the contamination of groundwater by agricultural chemicals have continued in cooperation with various state and federal agencies. The studies continue to focus on the Big Spring Basin in Clayton County and on Floyd and Mitchell counties. Studies completed in 1985 corroborate previous results and continue to provide necessary information for assessing groundwater protection policy needs. These data indicate that contamination of groundwater from agricultural chemicals is common in the shallower recharge areas of bedrock aquifers, shallow drift aquifers, and alluvial aquifers. A review of data statewide suggests that nonpoint-source agricultural chemical contamination of aquifers may be more severe in western Iowa than in northeastern Iowa.

Increased and excessive nitrogen fertilization and poor nitrogen management have resulted in nitrate concentrations in groundwater which are above accepted health standards. In 1984 over 40 public water supplies exceeded the health standard for nitrates. These studies in northeastern Iowa have shown that in a wet year, an equivalent of over 50 percent of the fertilizer-nitrogen applied may be lost to water supplies; even in a normal year, more than 30 percent may be lost. These data clearly show that the losses are an economic as well as an environmental concern.

Increased pesticide usage on corn and soybeans has also led to the contamination of groundwater by pesticides. Many of the most commonly used herbicides have been detected in groundwater in Iowa; some now occur throughout the year. These pesticides generally appear in very low concentrations (0.1 to 1.0 part-per-billion) but locally have exceeded 20 parts-per-billion. The continuous record from the IGS studies, coupled with information from the University Hygienic Laboratory, indicate that pesticide residues are increasing in groundwater, perhaps analogous to the rise in nitrates of a decade ago. The long-term health effects from such chemicals in drinking water are unknown. These studies have been partially supported by the U.S. Environmental Protection Agency during the past year; analytical costs have been partially supported by the Iowa Department of Water, Air, and Waste Management (DWAWM) and the University of Iowa Hygienic Laboratory. Evaluation of agricultural drainage wells is the new focus in research conducted during 1985 in Floyd and Mitchell Counties. Through a contract with the U.S. Environmental Protection Agency, IGS collected and studied bedrock cores, installed monitoring wells in various aquifers, and collected repetitive water quality analyses as a part of

this evaluation. Results and conclusions will be available during 1986.

Big Spring Basin Demonstration Project

The Big Spring Basin Demonstration Project is a cooperative, interagency program designed to demonstrate and document economically viable techniques to protect groundwater from the nonpoint-source contamination of agricultural chemicals. It is an outgrowth of the interagency Ad-Hoc Karst Committee. The seven-year program is being conducted in a 103 square-mile basin in northwest Clayton County because previous research and the area's geology provide a unique opportunity to measure and assess groundwater quality in relation to agriculture. The basin functions as a large, natural, outdoor laboratory. Throughout the project, agricultural activities and groundwater will be monitored within the basin. The Big Spring Fish Hatchery, where most of the basin's groundwater discharges, will receive special monitoring attention. Such control will provide assurance that conclusions drawn about the movement of agricultural chemicals into groundwater are applicable to groundwater protection throughout Iowa. Groundwater protection is expected to occur as more efficient ag-chemical management is documented and farm managers voluntarily employ alternative management practices in their farming operations. Agency participants believe the adoption of better chemical management practices should result in more efficient, economical crop production as well as groundwater protection. Successful ag-chemical management research, combined with special educational programs, form the core of the Demonstration Project. Experimental farm plots will be developed to document management practices and to demonstrate their potential to area farm managers. Drawing upon research results, education programs will assist farm managers to employ efficient fertilizer and pesticide management techniques within their farming systems. These programs will be combined with special assistance in the areas of soil conservation, and nutrient and pesticide management. The project also includes economic analyses of management practices, a careful evaluation of surface-and groundwater quality, and an evaluation of how effective educational programs can be to implement a non-point source groundwater-protection strategy.

The entire project is projected to cost 6.8 million dollars. Currently, 2.6 million dollars has been secured. Most of this comes from existing services pledged by agency programs, but it includes several small grants, contracts, or commitments from special project programs. The additional 4.2 million dollars is absolutely necessary to assure the success of the project. These funds are being sought from federal sources, as well as from foundations which might consider participation in such a project. Although the project receives significant staff support within potential funding-source agencies, our efforts to secure major funds for the project have not been successful, yet. The project includes the active cooperation and participation of the following agencies: Agricultural Experiment Station (ISU), Clayton County Soil Conservancy District, Cooperative Extension Service (ISU), Department of Agronomy (ISU), Institute of Agricultural Medicine (U of I), Iowa Conservation Commission, Iowa Department of Soil Conservation, Iowa Department of Water, Air and Waste Management, Iowa Geological Survey, Northeast Iowa Conservancy District, University Hygienic Laboratory (U of I), U. S. Agricultural Stabilization and Conservation Service, U. S. Environmental Protection Agency, U.S. Geological Survey, and U.S. Soil Conservation Service.

Consultative Investigations

As a necessary service, IGS has always performed investigations of critical problems for Iowa's regulatory agencies. For individual investigations that require excessive amounts of time, travel, or other costs, the agencies may share the cost burden, but for the majority of these investigations IGS absorbs the cost. These are necessary investigations which generally cannot be foreseen, and always interrupt the scheduling of other planned projects. Thus, flexibility must be built into IGS's longer-term projects.

Toxic and Hazardous-Waste Sites

Staff have provided general information to DWAWM and the U.S. EPA on numerous sites involved with the Resource Conservation and Recovery Act and Superfund programs. Site reviews generally include evaluating the general hydrogeologic setting, identifying and detailing the nature of groundwater supplies used in the area, and evaluating monitoring plans.

The staff have also provided more detailed investigations of sites for DWAWM and county or local health departments and fire marshals involving pesticide dumps and spills, hazardous-waste disposal, and petroleum leaks and spills. These projects have involved investigative field work, directing field investigations by other agency personnel, review of consultants' reports, testimony at formal proceedings, and oversight of clean-up operations in some cases.

In this general area, the review of progress and data from the LaBounty arsenic disposal site, investigation of the Des Moines TCE problems, waste oil and sludge at Grease Lake, and the Aidex pesticide site are continuing affairs.

Other Waste-Disposal Sites

Geological Studies staff also provide reviews of plans for all newly proposed or expanded landfills. In addition, because of the collapse of a newly constructed sewage-disposal system, IGS has been asked to review all waste-disposal operations in northeastern Iowa. IGS also cooperated with DWAWM on revision of sewage lagoon siting requirements in response to these problems.

Other Water and Land Issues

Staff routinely provided review and information on a number of other issues including:

1. Design and analysis of pumping tests for DWAWM well-permit hearings.
2. Information or testimony for various hearings regarding water permits obtained from DWAWM.
3. Consultation on natural land-boundary disputes for the Iowa Conservation Commission and/or the Attorney General's office.
4. Continuing consultation on Indian land cases along the Missouri River.
5. Review and testimony regarding the ETSI water-allocation litigation.
6. Review of new rules and regulations proposed by Iowa and federal regulatory agencies.

Site-Development Potential

Requests for information regarding site-development potential is an area that has increased markedly over the past two years. As the cost of development increases, it has become more common to seek preliminary information on alternative sites before expensive on-site investigations are undertaken. Of particular note are a number of requests (primarily from eastern Iowa and the Des Moines area) for information concerning engineering-geologic conditions for foundations and/or potential problems for new commercial/industrial construction. The requests have come directly from the interested commercial/industrial firms, from engineering-consulting firms or architectural firms which represent clients, and from various state and local government agencies involved with commercial development, including the Iowa Development Commission. As IGS expertise in this area has become better known, the number of requests has risen.

Parallel to these inquiries have been information requests regarding general soil-geologic and drainage conditions, the suitability of sites for sewage disposal, water and utility lines, and the possible economic value of soils in various development areas. These requests have come from state, local, and federal agencies, several Iowa municipalities, regional planning agencies, and private firms and individuals.

Cooperative Applied Soils Research

Staff of the Geological Studies Division direct, coordinate, and/or participate in ongoing cooperative research programs of the Iowa Cooperative Soil Survey (USDA-Soil Conservation Service and Iowa State University Experiment Station and Extension Service), and the Geotechnical Research Group, Department of Civil Engineering, Iowa State University. These programs are designed to assist and improve soil-survey operations, and to evaluate engineering properties and problems associated with soil mapping units or geologic units, as appropriate.

As an ongoing part of the cooperative applied soils research, IGS provides geologic data and topographic maps to aid in the initial stages of county soil surveys. Division staff participate in field reviews to assess mapping problems. IGS serves as an ex-officio advisor to the Cooperative Soil Survey Planning Group.

REMOTE SENSING LABORATORY

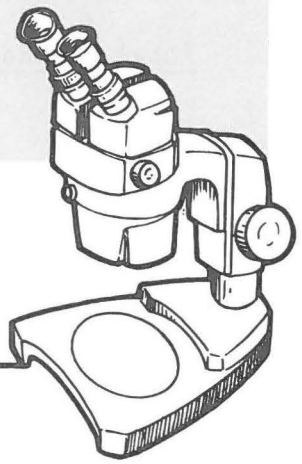
Southwestern Iowa Geophysical and Geologic Database

Work continued on acquiring new data and constructing a detailed database of geologic, geophysical, and remote-sensing data for southwestern Iowa. Investigations using this information will center on the Midcontinent Geophysical Anomaly (MGA), its hydrocarbon potential, structural description, and influence on subsequent geologic history. New data acquired this year includes two Landsat Thematic Mapper images, NURE aeromagnetic data, and digital topographic data. The Landsat scenes and topographic data will be analyzed for the presence of surface features which may be expressions of subsurface faults and fractures related to the MGA. Basement features will be analyzed indirectly with gravity and aeromagnetic data. A detailed compilation of gravity data from several surveys was completed in 1985. This data is helping to evaluate structures within the MGA and its flanking basins. In May, 1986, a new data set will become available when the USGS acquires digital side-looking airborne radar as part of their national mapping program. The radar data will be analyzed in a manner similar to the Landsat and topographic data, but its superior resolution should add new information to the database.

Saylorville Resource Evaluation

Work was completed and a final report submitted to the U. S. Army Corps of Engineers, Rock Island District on an investigation of the Late Wisconsinan and Holocene geology and geomorphology of the Saylorville Reservoir area in the central Des Moines Valley. The investigation resulted in the development of a landscape evolution model which combines uplands, valley slopes, tributaries and the main valley into a unified geomorphic system. Several distinct landform/sediment assemblages were described and mapped throughout the project area. Extensive radiometric dating of materials enclosed within the landform/sediment assemblages permitted construction of a detailed picture of the Late Wisconsinan and Holocene evolution of the project area. Results of the study will be used to help evaluate and manage cultural and natural resources within the Saylorville Lake area as the Corps further develops the area.

Stratigraphy and Economic Geology



BASIC GEOLOGIC DATA ACQUISITION AND STUDY

Basic rock data in Iowa is developed from the systematic collection and study of rock chips collected from drilling water wells (well cuttings), continuous cores of rock obtained from IGS research programs or industry, and exposures of rock in quarries, along road cuts, or along streams and rivers. By far the largest amount of data is derived from well cuttings. Of the 93 Iowa well drillers contacted in 1985, 22 save samples for the IGS on a regular basis, 32 save samples periodically, and 39 save samples of individual wells at our request. Their cooperation is vital to our understanding the geology of Iowa. The following table provides a summary of research activity during 1985.

IGS Rock Samples Received, Processed, and Studied in 1985

	Number of wells or sites	Total Feet
Samples received:		
Well cuttings	150	45,000
Rock cores	9	5,517
Well cuttings processed	148	45,486
Samples studied:		
Well cuttings	68	30,877
Rock cores		
Detailed logs	8	2,013
Reconnaissance logs	7	1,700
Outcrops studied:		
Detailed measurements	38	1,532
Reconnaissance measurements	4	60

The well cuttings, rock cores, and outcrops studied during 1985 add to the information previously compiled. Following are actual counts and estimates of the total rock data available at IGS at the end of 1985.

Total IGS Rock Samples Received, Processed, and Studied Through 1985

	Number of wells or sites	Total Feet
Samples received:		
Well cuttings	28,046	7,550,000
Rock cores	813	97,917*
Well cuttings processed	27,589	7,300,000
Samples studied:		
Well cuttings	20,480	6,530,000
Rock cores		
Detailed logs	108	12,025
Reconnaissance logs	257	31,700
Outcrops studied:		
Detailed measurements	2,035	61,500
Reconnaissance measurements	2,005	60,050

*Most cores are not complete from top to bottom. The number represents the feet of core collected from the 813 holes. The core was recovered from holes which represent about 361,300 feet of section.

The backlog of unstudied wells is large, and new DWAWM water well permitting rules may increase our backlog. Following is a tabulation of unstudied well data.

IGS Unstudied Wells (Rock Cuttings)

	Number of Wells	Approx. Footages
Bedrock wells:		
Iowa wells	4,742	731,000
Out-of-state wells	20	6,000
Wells not reaching bedrock:		
Iowa wells	2,778	280,000
Out-of-state wells	26	3,000
TOTAL	7,566	1,020,000

Additionally, about 54,500 feet of core has been collected which is currently unstudied. The study of rock cores is very time consuming, but rich in information. Normally, cores are studied only in direct response to particular problems. Their availability is invaluable, however, because even if they are not fully studied immediately, their curation may provide information for the researching of future problems.

RESEARCH PROJECTS

Iowa Stratigraphic Study

The Stratigraphic Study is a comprehensive reevaluation of the entire rock sequence in Iowa. It includes a restudy of each geologic system and constitutes the major research effort of the division. Reports on each geologic system will be completed before the centennial year of the Iowa Geological Survey in 1992.

To conduct this study, previous data are being merged with new data collected in the field. These data are often analyzed in ways which were not available previously. Rock exposures in quarries and along road cuts and streams are being carefully described and sampled. Rock descriptions are being combined with microscopic examination, especially petrographic and micropaleontological analyses, in order to recorrelate them and aggregate them into more appropriate units. Geophysical logs and geochemical data which were not available earlier are also an integral part of this restudy of Iowa's rock sequence.

The work completed to date on the Stratigraphic Study has been very useful in a number of on-going IGS projects. Maps and cross-sections produced have been widely distributed to exploration geologists in the petroleum industry and were the primary data source in locating several drilling sites. New stratigraphic interpretations have also been instrumental in groundwater quality and quantity studies presently in progress in northeast and north-central Iowa and will be an integral part of a recently initiated groundwater study in southwest Iowa. Additionally, it benefits such cooperative studies as the U.S.G.S. Midcontinent Strategic and Critical Minerals Program, Decade of North American Geology program, and Deep Observation and Sampling of the Earth's Continental Crust project.

Decade of North American Geology (DNAG)

Personnel from the Stratigraphy and Economic Geology Division (STRECOG) participated in a number of projects in 1985 related to the Geological Society of America's massive compilation of geological information for a centennial observance, the "Decade of North American Geology." Witzke and Bunker completed a summary of Phanerozoic geology of the central midcontinent (Iowa, Nebraska, Kansas, western Missouri). Additionally, STRECOG produced descriptions and stratigraphic sections of seven rock exposures in Iowa, for inclusion in the DNAG guidebook series. The completed sequence of DNAG publications will provide the base for many future geologic studies and exploration projects in North America.

Plum River Fault Zone Report

The study of the Plum River Fault Zone in east-central Iowa culminated with the publication of a report on this feature in 1985. The report summarizes the Middle Ordovician through Middle Devonian stratigraphy, including the formal presentation of new Silurian nomenclature and new Middle Devonian stratigraphic hierarchy. It also outlines the structural history of eastern Iowa with text, maps, and cross-sections, and describes the Phanerozoic movements along the fault zone. Finally, evidence of more recent movement along the Plum River Fault Zone is described, and possible historical seismic activity is discussed.

Midcontinent Strategic and Critical Minerals Programs

In 1985 STRECOG continued its participation in the Midcontinent Strategic and Critical Minerals Program, a U.S.G.S.-sponsored study of geology and minerals resources in Iowa and portions of eleven surrounding states delineated by latitudes 36° to 44°N and longitudes 88° to 100°W. Anderson directed a field investigation of rocks in the Lake Superior region, as part of a study of the Midcontinent Rift Zone, and convened a meeting in Denver of 25 geologists presently studying the Trans-Hudson Orogenic Belt and topics related to its southern extension into the United States. Additionally, STRECOG participated in meetings organized to discuss mineral potential beneath the Sioux Quartzite and potential manganese mineralization flanking the Sioux Ridge. A series of Iowa maps and cross-sections were compiled. These include:

1. Phanerozoic Structural Features in Iowa
2. Isopach of Mississippian Carbonates in Iowa
3. Limestone/Dolomite Isopleth of Mississippian Carbonates in Iowa
4. Lithostratigraphic Cross-section of the Total Mississippian System Along 41° Latitude in Southern Iowa.
5. Lithostratigraphic Cross-section of the Total Mississippian System Along 42° Latitude in Central Iowa.

Fossil Amphibian Site Discovered

A significant fossil amphibian site was discovered by Bob McKay (STRECOG) and former IGS geologist Pat McAdams in 1985. The site, an unexpected product of field studies associated with the Stratigraphic Study, produced the preserved remains of the oldest known amphibians in the United States. IGS has obtained a lease to collect these fossils and study the site. Work will be conducted in cooperation with the Field Museum of Natural History, Chicago. Preliminary collections and stratigraphic studies have been completed, and an article describing the site and the fossils discovered has been prepared and submitted to *Science* for publication in 1986. Future planned activities include securing funds for complete excavation of the site, fossil preparation, study and curation.

SERVICE

Oil and Gas Exploration in Iowa

In 1985 STRECOG responded to about 400 requests for information on oil and gas exploration in Iowa. These requests included technical information for petroleum exploration and service companies, general information to Iowa residents, and interviews with the media. During the year, STRECOG was contacted by six major oil companies, 32 independent oil companies, and 24 consultants and service companies. Geologists from seven companies visited our offices for information and to examine samples in our rock library.

Unprecedented high levels of petroleum exploration and leasing activity continued in 1985. An estimated 1500 miles of deep seismic profiles were produced in Iowa in 1985 by AMOCO, Western Geophysical, Geosource Inc., and other unidentified companies. We estimate that about six-million acres of Iowa land have been leased by oil leasing companies along the trend of the Midcontinent Geophysical Anomaly.

Two oil tests were drilled in Iowa in 1985. These were the #1 Josephson, drilled in Montgomery County by Milo Ditterline and later plugged with no reported oil, and the Bombei #1, started in Washington County by CST Oil and Gas Corp. but not completed in 1985. Also in 1985, AMOCO announced plans to drill a deep petroleum exploration test hole in Carroll County in 1986. The test will be the first exploration of the Midcontinent Rift in Iowa, and only the second test well along the feature's 700-mile length. The well is projected to reach a total depth of between 15,000 to 18,000 feet, shattering Iowa's previous well depth record of 5,305 feet. It will cost an estimated $4 to $6 million. Although AMOCO intends to begin drilling in 1986, continued decreases in the price of crude oil could result in postponement of drilling.

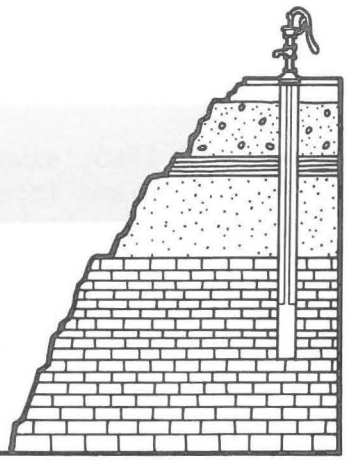
Service to Iowa's Mineral Industry

In 1985 STRECOG responded to 33 requests for information from Iowa's stone, clay, gypsum, and sand and gravel producers. These included visits to an underground mine in Marion County, to provide advice on problems encountered during the construction of a new ventilation shaft, and to an underground mine in Louisa County to assist in the resolution of problems associated with the presence of numerous pockets of clay in the limestone being produced at the site.

Service to the Public

STRECOG geologists responded to over 400 requests for geological information in 1985. These requests ranged over a variety of subjects including latitude/longitude locations, elevations, resource assessments, rock identification, oil exploration and leasing, earthquake potential, rock and fossil collection locations, and a variety of other topics. In addition they organized and conducted several field trips, which explored geologic features of interest with the scientific community and general public, and gave talks on petroleum exploration in Iowa and recent stratigraphic studies.

Water Resources



SERVICE ACTIVITIES

Well Forecasts and Advice on Groundwater Problems

During 1985, Division staff responded to over 500 individual requests for advice on the development of new wells or procedures to be followed in correcting specific well problems.

A typical well forecast is a letter report that provides site-specific information on the thickness and sequence of geologic formations to be encountered during drilling, formations that will provide water, the anticipated rates of yield, and the expected quality of water. Depending on the detail and precision required by the request, an individual report may take from four to over eight hours to prepare. For 1985, approximately 20% of the Division's staff time was spent on this and related activities. The sources and numbers of information requests are listed in the following table and are compared with similar data for 1983 and 1984.

Category	1983	1984	1985
State/Federal Agencies	37	46	9
Municipal	118	142	100
Commercial/Industrial	76	71	69
Domestic	151	137	81
Irrigation	6	11	25
Institutional	0	0	1
Housing Developments	7	8	3
Rural Water Systems	1	0	0
Recreation	4	3	16
Livestock Operations	12	4	0
General Review	0	3	9
Pumping Tests	0	3	9
Hazardous Waste Sites, Landfills	*	*	21
Other	56	69	120
Totals	482	508	512

* category not included in prior years.

Assistance to the Division of Mines and Minerals (DSC) and Coal Mine Operators.

During 1985, numerous written and telephone responses were made to coal miners, state and federal mine regulators, and private parties regarding information and technical assistance on coal occurrence and quality, underground-mine maps, and mine-subsidence problems.

Division staff continued its assistance to the Department of Soil Conservation, Division of Mines and Minerals, in the technical review of operators' mine plans and subsidence-control plans. Such plans are required for new coal mine operations before approval and permitting. The Division also aids in coordinating other coal related activities of the Department of Soil Conservation. One activity in this area is the restoration of historic mine maps which is being conducted by the Iowa Historical Department. This work is funded by the U.S. Office of Surface Mining, administered by the Department of Soil Conservation, and coordinated by Division staff. Other functions in this area include the development of the Iowa Coal Mine Data Base and the initiation of a study of coal mining and subsidence phenomena in Appanoose County. This work is funded by the Iowa Abandoned Mine Lands Inventory program.

RESEARCH ACTIVITIES

Although a key agency/division goal is to assist Iowa's industries, businesses, communities, and citizens in the development of water supplies to meet their needs, there is also an awareness that the state's water resources are limited. Division research objectives have been adjusted to consider the budgeting aspects of groundwater management -- how much is available; what rates of withdrawal can be sustained; how much is used, where and for what purposes; and how much additional water can be safely allocated. Because future state water-allocation strategies are being developed, these kinds of information are receiving a high agency priority.

Municipal Water-Supply Inventory

A comprehensive inventory of the water supplies of the state's communities has been completed. The project has expanded our knowledge of community water developments and allows IGS to be more effective and efficient in servicing Iowa communities. The inventoried data were taken from files maintained by the six regional offices of the Department of Water, Air and Waste Management (DWAWM).

The data compiled include: location and design of wells; geologic source of water; rates of pumping; water use and water quality. These data have been merged with existing IGS data to generate a comprehensive information base. The data have been coded and entered into the Municipal Water Supply Inventory (MWSI) file, which currently is accessible in INFO on the University of Iowa Computer System. When final operational details are agreed upon by DWAWM and IGS data processing staff, the MWSI will be transferred and implemented on the Integrated Data Management System (IDMS) in Des Moines. This final step will allow MWSI to be used by DWAWM in Des Moines, its six regional offices, and any other user with access to IDMS. The MWSI will be updated periodically by IGS with the cooperation of DWAWM's regional offices.

The MWSI includes information on 812 municipal supplies and 30 rural water associations. Ninety-four percent of the municipal supplies and seventy-three percent of the rural water associations rely at least in part on groundwater. Six percent of the municipal supplies and twenty-seven percent of rural water associations use surface water. There are nearly 2,000 active municipal supply wells in the state, an average of about 2.6 per community. About seventy-four percent of the state's population is served by municipal water.

Alluvial Aquifers Program

The assessment of alluvial aquifers in northwest Iowa, which first began in 1981, has continued throughout 1985. A total of 86 monitoring wells have been installed along the Rock, Ocheyedan, Little Sioux, and Des Moines rivers. Many of the well sites are multiple completions -- two to four wells at each location. Each well is used to monitor different depths within the aquifer. Sixty-five of these wells are sampled monthly or bimonthly for nitrate and coliform bacteria and occasionally for pesticides.

Results to date show that nitrate concentrations vary temporally and generally rise in response to increased infiltration associated with precipitation. Vertical stratification of nitrate has been found in each of the alluvial systems. Generally, nitrate levels decrease with depth and the highest concentrations are found in the top 10 feet of the saturated aquifer. Anomalies occur in some locations where nitrate concentrations are very low or absent but other agricultural chemicals are present. In such instances, denitrification is suspected as the mechanism for nitrate reduction. Examination of soil cores and dissolved oxygen measurements indicate that environments favorable for denitrification exist at many places in the alluvium.

Atrazine is the only pesticide that has been found in IGS alluvial sampling on these rivers. However, samples from municipal systems along these rivers have shown Lasso, Dual, Bladex, Dyfonate, Counter, and Sencor to be present. Atrazine is found year round; other varieties are found only in the spring and summer months. Coliform bacteria is pervasive through the alluvial systems and may be mainly soil bacteria. However, some wells examined specifically for fecal coliform have tested positive. Further testing is underway to evaluate the specifics of the bacteria present. Sampling will continue through the summer of 1986.

Preliminary work has started on several other alluvial systems. These include the: West Fork Little Sioux River, Maple River, North Racoon River, and Beaver Creek. Seismic investigations are underway to determine the geometry of these alluvial systems. Approximately 22 miles of seismic lines were run during the summer of 1985.

Water Resources of Northeast Iowa

A regional water atlas covering eleven northeastern Iowa counties is in preparation. The objective of this project is to summarize the availability, quality, and use of water in an area which includes: Howard, Winneshiek, Allamakee, Chickasaw, Fayette, Clayton, Bremer, Black Hawk, Buchanan, Delaware, and Dubuque counties. The first draft of this atlas is nearing completion.

Southwest Iowa Groundwater Study

A four-year program was launched to study groundwater availability in southwest Iowa. The study area is comprised of the following counties: Pottawattamie, Cass, Adair, Mills, Montgomery, Adams, Fremont, Page, and Taylor. The first project year, 1985, was devoted to the researching, collation, and evaluation of extant data on the Dakota, buried-channel, and alluvial aquifers of the region. Because the deep rock aquifers of the region are highly mineralized, the previously mentioned aquifer systems will be the focus of the investigation. Locally, however, the Pennsylvanian system may also be evaluated.

The field work and test drilling associated with this project are currently being planned and will be conducted during the summers of 1986 and 1987. The project is a cooperative project between IGS and the U.S. Geological Survey and is scheduled for completion in 1988. The objectives of the project will be to define the occurrence, development potential, and water quality characteristics of groundwater in the Dakota, buried-channel and alluvial aquifer systems.

Skunk River Basin Project

This investigation is being conducted by IGS under contract with the U.S. Soil Conservation Service. The work to be done is an element of a comprehensive study of the Skunk River Basin by SCS. IGS will prepare geologic and soil thickness maps for the Skunk River Basin, define the groundwater resources of the basin, and evaluate trends in groundwater quality that may relate to land management practices in the study area.

Cedar Valley Aquifer, Charles City

IGS and DWAWM are currently negotiating the details of a study to investigate the hydrology of the Cedar Valley Aquifer in the Charles City area. The study will reevaluate the necessity for the current groundwater development restrictions that have been imposed by DWAWM to protect the aquifer from contamination by the La Bounty toxic waste site. The plan calls for controlled test pumping of the aquifer to better define the aquifer's hydraulic properties. This information will be used in the calibration of a three-dimensional computer model that will be employed to simulate the effects of additional or potential water development in the area. The computer will allow for the simulation of several different water-development scenarios on the hydraulic balance that exists within the aquifer. DWAWM needs to determine if their existing restrictions can be modified in ways that will allow more water development in the area, and at the same time assure that water in the aquifer will not be contaminated by chemicals from the La Bounty site.

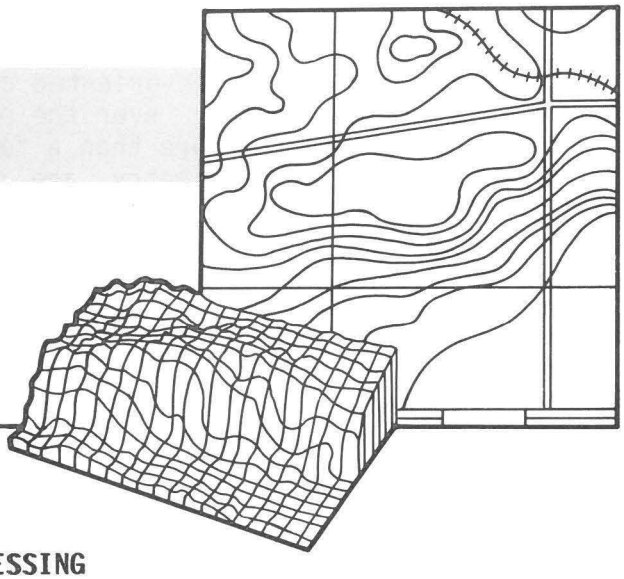
OIL, GAS, AND METALLIC MINERALS

As provided in Chapter 84 of the Code of Iowa, the State Geologist is designated as the Administrator of Oil, Gas, and Metallic Minerals, and is responsible for administering the provisions of Chapter (780) 29 of the Administrative Code. His duties include: issuing permits for oil, gas and metallic minerals exploration; issuing permits for wells for underground gas storage; and the oversight of drilling operations and well and site abandonment. Division staff assist the Administrator in these activities.

Three drilling permits for oil and gas exploration were issued during 1985. They were issued to Milo Ditterline, Golconda, IL; CST Oil and Gas, Aurora, CO; and Pan American Petroleum, Chicago, IL. The tests were scheduled to be drilled in Montgomery, Washington, and Carroll counties respectively. The test in Montgomery County was drilled and abandoned; testing is still being conducted in the Washington County well; and the deep test in Carroll County was not started in 1985.

IGS continued to serve as the Commerce Commission's consultant with respect to the abandonment of the Northern Natural Gas underground storage facility at Vincent. Currently the acreage remaining under lease at Vincent remains as it has since 1971, 12,373 acres. The gas remaining in storage was reported to be 2,404,917 Mcf as of December 26, 1985.

Technical Services



DATA PROCESSING

In keeping with its role of service within the Iowa Geological Survey, the data processing staff has contributed programs, products and services to meet a variety of needs this past year. Perhaps the most significant project has been the design of a database for installation on the Comptroller's Data Processing system at Des Moines. This database will give CDP users access to thousands of water resource and geologic records that are now available on the computer at the Iowa Geological Survey and on the University of Iowa computer system. Cooperation through a related project at the Department of Water, Air and Waste Management has resulted in a database that supports the needs of both agencies. A key element in this cooperative effort is the Municipal Water Supply Inventory Database that has been made operational at the University of Iowa's computer center. Staff at DWAWM and IGS collaborated on the compilation of information for this database, and it will be integrated with DWAWM's related water supply database during the coming year. At present, the inventory is accessible via dial-up terminals authorized to use a special interagency account with the University of Iowa computer center. The Municipal Water Supply Inventory includes ownership, construction, geologic treatment, and pumpage information for 812 towns and 30 rural water districts.

A second area of program development was the geologic sample inventory system. This program, called GEOSAM, is used to keep track of all the drill cuttings and other geologic samples stored at the Iowa Geological Survey facility at Oakdale. Computerization of sample tracking allows quick reporting on the availability of samples for areal studies and also provides monitoring of progress in sample processing, study and data entry.

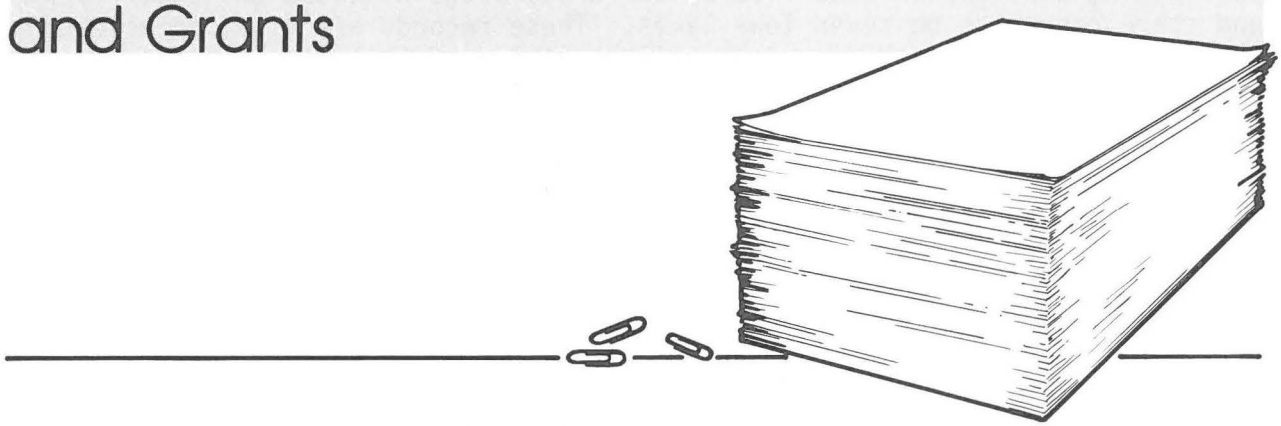
To aid the study of contamination of groundwater by pesticides and nitrates, a set of custom programs was developed for entry, storage, retrieval and display of water quality and discharge in the Big Spring Basin. Tables and charts of various types can be produced by the project staff as they are needed.

The state's collection of historical coal mine maps represents one crucial record of the location and extent of coal mines in Iowa -- many of which are long since abandoned. Information about these maps and a large amount of additional information about the mines themselves, is being compiled under a contract with the Iowa Department of Soil Conservation. All available computer-based information will be accessible through this system by October, 1986. At this time the database and system specifications have been designed, and the research and data entry phases are underway.

A large number of user-oriented computer routines have been installed at the Iowa Geological Survey over the past several years. Out computer system is incapable of serving more than a few users at a time, and a number of applications, such as data entry, are wasteful of human resources if they are not handled promptly by the computer system. Economic considerations and new micro-computer technology have led us to favor "extension" rather than "expansion" of computer resources. Some computing tasks are now being performed by micro computers, leaving the main system available for the tasks for which it is best suited. For example, current data entry software on the Perkin-Elmer computer requires around 150k of main memory and must contend with many other users for access to disk memory. Personal computers have been acquired for use in project data entry and management, and for future use in the production of graphs and tables. Geologic data queries, special purpose analytical functions, satellite image processing, geographic database development, data management chores, and much of the data communications load are handled by the Perkin-Elmer. Still, staff usage exceeds our system capabilities, and further micro-based system extensions and minicomputer expansions are needed in the near future.

During the coming year we look forward to adaptation of staff skills and services to new technical developments and to the emerging computer-sophistication of our clients.

Contracts and Grants



U. S. Geological Survey Cooperative Programs

Topographic Mapping

The cooperative topographic mapping program has shown little progress during 1985. The 1:24,000 scale topographic series was not completed as expected. The 12 maps needed to complete the set for the state (1083 maps) are still only available in preliminary form.

Progress in the 1:100,000 scale county topographic maps has been minimal. Three of the 36 counties authorized in agreements were delivered in 1985: Black Hawk, Iowa, and Shelby counties. Slow delivery of final products can be explained, in part, by a policy change. The first maps were compiled in metric units (meters). The USGS changed policy on metrification and agreed to print maps in English units (feet) if cooperators desired. IGS requested that the original work, and all subsequent cooperative mapping projects, be compiled and printed in conventional English units. Changes to maps already compiled slowed final production. The production of another 1:100,000 scale series of maps (not under cooperative agreements) have also slowed production of the county maps. Of 40 quadrangle maps which cover Iowa, each depicting an area 30 minutes of latitude by 60 minutes of longitude, there are 16 planimetric maps and 5 topographic maps now available. The rapid production of these planimetric maps for the Bureau of the Census has slowed production of maps covered by the cooperative agreements with Iowa.

Water Resources

During the past year, IGS has continued a cooperative program with the Iowa District Office, Water Resources Division, U. S. Geological Survey. The program is intended to collect, analyze, maintain, and publish data and information pertinent to understanding and managing Iowa's water resources.

Results of most data collection programs are maintained on computer files and published annually. Water Resources Data, Iowa Water Year 1985 contains the data collected from the stream-gaging program, the groundwater monitoring project, and sediment data-collection project. The results of other projects are published at their conclusion. Reports are published either by the U. S. Geological Survey or IGS.

Stream-gaging program: The U.S. Geological Survey maintained 116 continuous-gaging stations on Iowa rivers, 125 crest-stage stations on Iowa rivers, and stage recorders on seven Iowa lakes. These records are vital to assessing our water resources and are especially useful and basic to any engineering studies along Iowa rivers. The U.S. Army Corps of Engineers is the largest contributor to the gaging program which is also supported by the State, municipalities, industries, and other organizations. State money for this purpose is channelled through IGS and is used to support 30 gaging sites as listed in the following table.

Continuous-Gaging Stations Cooperatively Supported: IGS-USGS

Stream	Station Number	Location
Big Cedar Creek	05412870	Varina, Pocahontas Co.
Cedar Creek	05473400	Oakland, Mills Co.
East. Br. Iowa River	05449000	Klemme, Hancock Co.
East Fk. Hardin Creek	05483000	Churdan, Greene Co.
Iowa River	05449500	Rowan, Wright Co.
Little Sioux River	06606600	Correctionville, Woodbury Co.
Maquoketa River	05418500	Maquoketa, Jackson Co.
Middle Raccoon River	05483600	Panora, Guthrie Co.
Nodaway River	06817000	Clarinda, Page Co.
North Fk. Maquoketa River	05418450	Fulton, Jackson Co.
North Raccoon River	05482300	Sac City, Sac Co.
North Skunk River	05472500	Sigourney, Keokuk Co.
Ocheyedan River	06605000	Spencer, Clay Co.
Platte River	06818750	Diagonal, Ringgold Co.
Shell Rock River	05462000	Shell Rock, Butler Co.
Skunk River	05474000	Augusta, Des Moines Co.
South Skunk River	05470000	Ames, Story Co.
Tarkio River	06811840	Stanton, Montgomery Co.
Turkey River	05412500	Garber, Clayton Co.
Turkey River	05412500	Spillville, Winneshiek Co.
Wapsipinicon River	05411600	Elma, Howard Co.
Wapsipinicon River	05421000	Independence, Buchanan Co.
Weldon River	06898400	Leon, Decatur Co.
West Nishnabotna River	06807410	Hancock, Pottawattamie Co.
Winnebago River	05459500	Mason City, Cerro Gordo Co.

Continuous-Gaging Stations Cooperatively Supported:IGS-USGS-Corps of Engineers

Stream	Station Number	Location
Boyer River	06609500	Logan, Harrison Co.
East Nishnabotna River	06809500	Red Oak, Montgomery Co.
Floyd River	06600500	James, Plymouth Co.
Little Sioux River	06607500	Turin, Monona Co.
Soldier River	06608500	Pisgah, Harrison Co.

Sediment station program: Fourteen locations on Iowa streams were monitored periodically for sediment load carried by the stream. The stations that IGS cooperatively supports are indicated in the table below.

Sediment Stations Cooperatively Supported: IGS-USGS

Stream	Station Number	Location
Iowa River	05454500	Iowa City, Johnson Co.
Nodaway River	06817000	Clarinda, Page Co.
Ralston Creek	05455000	Iowa City, Johnson Co.
Skunk River	05574000	Augusta, Des Moines Co.

Groundwater monitoring: Approximately 200 groundwater-quality monitoring sites are sampled each year from this program. Sites are selected from different aquifers throughout the state, and plans call for repeated water-quality sampling every five or six years.

Iowa River Aquifer: The alluvial aquifer between Coralville Reservoir and Belle Plaine is being monitored to evaluate water quality and resource availability. During 1985, 128 wells were monitored regularly.

West-Central Iowa Water Supply: The evaluation of water availability from and water quality of alluvial systems in west-central Iowa was completed and results were published. An interpretive report will follow in the future.

Bedrock Maps: The mapping of the topography of the bedrock surface is a very important factor in evaluating groundwater-resources potential and environmental problems. The central Iowa bedrock topography map was published, and the remaining two are expected in the near future to complete this series.

Southwest Iowa Water Supply: An evaluation of groundwater resources in southwest Iowa was begun in 1985. Extant data was collected and evaluated, and a drilling plan was developed.

National Coal Resources Data System

The National Coal Resources Data System (NCRDS) is a cooperative program funded by the U.S. Geological Survey. The purpose of the program is to compile data for evaluation of coal resources and reserves in Iowa and to transmit this data so it can be added to a national coal resource data base maintained by the U.S.G.S.

The portion of Iowa which is underlain by potential coal-bearing strata was divided into areas at the beginning of the project. Data collection was completed for Dallas, Hamilton, Hardin, Marshall, Polk, Story and Warren counties during 1985. Location maps have been prepared for all data points in each county. These maps show the extent of mineable coal by each coal seam and include outcrop/subcrop information, overburden thickness, and the location and extent of previously mined coals. All data are retained at IGS and sent to NCRDS for entry into a national data base on coal resources.

Data collection for a final block of twelve counties in central and southwestern Iowa began in October, 1985.

ABANDONED MINE LANDS INVENTORY

The Abandoned Mine Lands Inventory program is developed under a contract with the Iowa Department of Soil Conservation, Division of Mines and Minerals and funded with a grant from the U. S. Office of Surface Mining. The project entails four components.

1. Abandoned Mine Lands Problem Area Update and Review: Approximately 50 abandoned mine sites were evaluated or re-evaluated for the Abandoned Mine Lands Inventory. These evaluations on located sites describe their condition and evaluate the hazards which each pose.

2. Undergroud Coal Mines-Centerville, Iowa and Vicinty: Centerville and the surrounding area are extensively undermined by coal mines which operated there until 1971. A detailed study of mines in the area was begun in 1985 to document the location and extent of underground mines and to locate any areas which are experiencing problems which may be related to past coal mining activities.

Maps of abandoned coal mines and related data files were studied and areas which were most extensively undermined were identified. Personal visits were made to establish evidence of mine-related problems and to establish contact with local engineers, road and street repair crews, and others who might have knowledge of coal mine-related problems. Retired coal miners and local historians in the area were also contacted. They were of great assistance in clarifying the locations and histories of some mines about which the information on file at IGS was unclear.

The final products of the Centerville study will be a map showing the location and known extent of mines in the area, a report on the potential mine-related problems, and a list of other data from the mine files including depth, years of operation, and the type of mining operation for each site.

3. Iowa Mined Lands Data System: This portion of the project was devoted to the creation of a computerized database which will encompass all the sources of information on past coal mining in Iowa. The database brings together information which until now has been scattered and ambiguous. It will greatly facilitate access to mine-related data by IGS and DSC personnel both for their own use and for inquiries from outside engineers, landowners, contractors, and coal miners.

At the end of 1985, data from approximately 700 of the 1450 mine maps in IGS's possession have been prepared for entry into the data base system. The 700 maps represent approximately 500 sites which have been affected by underground coal mining. The database will include detailed histories of the names under which the mines operated throughout their active histories, location information, availability of maps, depth, type of mine, stratigraphic information and documentation of sources. The remainder of the mapped mines will be entered early in 1986. Study of surface mines and unmapped mines will follow completion of the database for the mapped mines.

4. Restoration of Coal Mine Maps: Restoration of the approximately 1450 maps of abandoned coal mines in IGS files continued with 859 maps completed. The map restoration is being done by the Iowa State Historical Department under a contract with IGS.

The restoration process involves cleaning, flattening, and repairing the map and then enclosing it in a sealed envelope of polyester film for preservation. When completed each map is photographed and the original stored at a specially designed facility where each map becomes available for reference.

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